Nutritional Security and Improvement of Yield through Mechanized Cultivation of Mungbean

Kbd. Mosaref Hossain[1], Md. Adil[2], Imtiaz Ahmed[3], Tapas Ranjan Chakraborty[4]

[1]PO-mAgri, Oxfam GB
Email: mohossain@oxfam.org.uk
[2]SO, Plant breeding division, BRRI
Email: adil_gbp@yahoo.com
[3]Sr. MEAL Officer, Oxfam GB
Email: iahmad@oxfam.org.uk
[4] Project Coordinator- ICT & Development, Oxfam GB
Email: Tchakraborty@oxfam.org.uk

Abstract— *Mungbean (Vigna radiata) is one of the major pulse crops in Bangladesh. It contains different nutrient, vitamins, mineral and amino acid. Agricultural machinery play an important role to reduce drudgery of farm works as well as minimize operational time and production cost. An experiment was conducted with three treatments viz. T_1 = Two Wheel Tractor (2WT) + Broadcasting seed, T_2 = Power Tiller Operated Seeder (PTOS) and T_3 = Strip Tillage (Two wheel tractor operated seeder modified as Strip tillage seeding) on farm research. The objective of this study was to achieve the goal of increased Mungbean production in Bangladesh through different tillage and seeding methods. Besides, to disseminate information in the farmer's level conservation tillage is new technology for increasing and sustaining productivity of Mungbean cultivation in mechanized way. From the study, the results revealed that seeding with Power Tiller Operated Seeder (PTOS) treatment was the most effective for production of Mungbean among all tillage and seeding methods in considering total yield 1582.53 Kg/ha. So, it may be concluded that the treatment Power Tiller Operated Seeder (PTOS) considered as the best treatment compared to all other treatments and it can be recommended for more Mungbean production and ensuring nutritional security.*

Keywords—Mechanized cultivation, power tiller operated seeder, strip tillage and two wheel tractor.

I. INTRODUCTION

Bangladesh is the most densely populated country of the world. Its present population is about 159 million which is increasing annually at the rate of about 1.42 percent. By the year 2030, the population will be increased to about 200 million. On the other hand, the cultivable land is decreasing by 1% every year [3]. Mungbean contains different nutrient, vitamins and mineral like as Prortein 24.5 gram, Carbohydrate 59.9 gram, Oil 1.2 gram, Minerals 3.5 gram, Iron 8.5 miligram, Calcium 75 miligram, Carotene 49 microgram, Vitamin B_1 0.72 miligram, Vitamin B_2 0.15 miligram, Energy 348 Kcal and Fibre 0.8 gram per 100 gram edible of Mungbean [12] and [6]. It also contains amino acid lysine, which is generally deficit in food grains [5]. Being leguminous, this crop maintains soil fertility by fixing the atmospheric nitrogen [10]; [15] and [16].

To meet up the pulses demand of increasing population, Mungbean production in the Rabi season needs to be increased, by increasing the present low yield (980 kg/ha), [2]. Among the factors responsible for the low yield of the Mungbean, non-mechanized cultivation is the important ones. Mechanized cultivation of pulse can reduce production cost and increase yield. Land preparation and sowing are expensive and time-consuming operations for Mungbean cultivation. Proper placement and distribution of seed and fertilizers into the soil is necessary for good germination and plant establishment for better yield [7]. Farmers face trouble completing agricultural operations due to labour shortage, especially during the planting season, during harvesting and threshing periods. Small agricultural machinery such as the power tiller, power tiller operated seeder and power tiller operated bed planter are alternative ways to manage labor shortage and keep crop production at a high and economic level.

The seeder creates 4-6 cm wide planting strip and produce good seed soil contact which facilities better plant stand. Depth of seed placement can be controlled easily. Seed placement vary 5-7 cm below the soil surface depending the moisture availability in the soil. The rotating strip blades can operate through moderate crop residues field without plugging. Strip tillage planting system in which tilling the planting strips and seeding can be accomplished simultaneously thereby reducing the number of field operations required. In this system land is remain untilled between the two seeding lines. The farmers are becoming more dependent on mechanical power. Now a day, power tillers are available all over the country.

Two wheel tractor operated seeder has 48 numbers of rotating blades for shallow tilling the soil. The seeding part of the seeder is attached with power tiller replacing the rotavator part of the power tiller. In strip tillage system, rotating tynes were reduced to 24 numbers. Only 4 numbers of tynes remain in the gang at front position of seed furrow opener for tilling and creating a strip in the soil. Between the two seeding lines soil remain untilled. The tynes of the seeder are rotated at the speed of 450 rpm.

Therefore, to achieve the goal of increased Mungbean production in Bangladesh, the present study was undertaken with the objectives to find out proper tillage and seeding method of Mungbean cultivation.

II. MATERIAL AND METHOD

The experiment was conducted in the Agro-ecological zone of Ganges Tidal Floodplain, AEZ-13 during the Rabi season 2014 on farm research. The land area is situated at 22.37882°N Latitude and 90.32012°E Longitude at an Altitude of 3 meter above sea level. The sufficient sunshine was available during the experimental period. The following treatments were included in this experiment.

The experiment consisted of three treatments

T_1 = Two Wheel Tractor (2WT) + Broadcasting seed: The land was ploughed and cross-ploughed two times with two wheels tractor. Then seeds were broadcasted by hands and completed final plough.

T_2 = Power Tiller Operated Seeder (PTOS): Power tiller operated seeder was modified and improved seeder which simultaneously creates a furrow and performs seeding in the furrow in one operation behind the power tiller machine and

T_3 = Strip Tillage (ST): Two wheel tractor operated seeder modified as Strip tillage seeding and Seeding operation was completed by the drill in one pass as tilling and creating a strip of wide 4-6cm, seed and fertilizer placed in the strip, and seed covering by the press roller.

Seeds of BARI Mungbean6 were collected from BARI, Joydebpur, Gazipur, Bangladesh. It is a high yielding Variety. It was released in 2003. Leaf and seed color are deep green and leaves are wide. Physical growth becomes less after flowering. Grain size is bigger. After wheat harvesting, seed can be sown till first week of April. Besides, the variety can be cultivated in Kharif-1, Kharif-2 and in late Rabi season. The variety is tolerant to yellow mosaic virus and leaf spot disease. The experiment was laid out in randomized complete block design (RCBD) with eleven replications. Each replication was first divided into three treatments. The size of the each treatment plot was 20m × 20m. The distance maintained between two treatment plots was 0.5m and that between replication was 1m. Fertilizers were applied basally (TSP and MOP). The amount of TSP @ 80 kg ha^{-1} (3.2 kg/treatment) and MOP @ 35kg ha^{-1} (1.4 kg/ treatment). Fertilizers were broadcasted before seed sowing, and then incorporated into the soil. Herbicide only is applied in Strip tillage treatment. At least four days before planting, apply 1 kg active ingredient (a.i.) Glyphosate using 320–400 L ha^{-1} (16 L/ treatment) of water with a three-nozzle flat-fan spray boom.

2.1 Seed calibration

Transparent polythene bags were tagged with each of the six seed delivery tubes. The seeder was operated on a pre-measured 20 m travel distance with a sowing width of 120 cm, thus providing 24m^2 area covering. After every 20m linear distance run, collected seeds through tubes were weighed separately and the total seed weight was also measured. This method was repeated by acceleration and deceleration of the lever of seed rate control until the desired seed rate obtained. Since the seed metering device was connected by a chain sprocket arrangement to the power tiller wheel axel, the speed of the tiller should not be a factor in calibration, unless there was excess wheel slippage. The seed rate was determined through calculation by using the following equation [11].

Sd = 10 Ws/Am; Where, Sd = Seed rate (Kg/ha), Ws = total wt. of seed (gm), Am= measured experimental area, m^2

2.2 Data collection

The following data were collected during the test: (i) Depth of tillage (cm), ii) Tillage Time (m), iii) No. of Plant/ m^2, iv) No. of pod/ plant, v) Pod length (cm), vi) 1000 Grain weight (g), viii) Grain Yield kg/ha and (ix) Stover Yield kg/ha.

Number of plants was measured by counting plant number from each one meter square frame randomly. Then simple calculation made for plant per square meter. Same procedure is followed in other treatment but 1m^2 area selected by the

handmade square frame. Grain yield was measured from 10 square meter area from each plots of crops. It was replicated 4 times.

III. RESULTS AND DISCUSSION

Tillage depth and time were significantly influenced by different tillage methods. It was observed that the highest tillage depth (5.42 cm) was obtained with power tiller operated seeder treatment. On the other hand the lowest tillage depth (4.71 cm) was shown by two wheel tractor treatment (Table 1). The more tillage time (24.13 min) was needed with two wheel tractor (2WT) and the less tillage time (11.06 min) & (8.02 min) were needed by power tiller operated seeder and strip tillage method respectfully. The effect of different tillage and seeding methods on plant height of Mungbean was showed significant variation (Table 1). The highest plant height (34.33cm) was recorded in power tiller operated seeder (PTOS) treatment which was significantly different from that of strip tillage (30.30cm), two wheel tractor (2WT) and seed broadcasting (32.39cm). On the other hand, the lowest plant height (30.30cm) was recorded in Seeding with strip tillage method. It indicates that different tillage and seeding methods played role in stimulating vegetative growth. Moreover, the plant height of Mungbean in case of power tiller operated seeder (PTOS) and seeding with strip tillage method indicates enjoyed similar favorable conditions throughout their growing period. These findings are accordance with those of [4].

Increase in plant population per square meter had significant effect on yield of per unit area. The number of plant per square meter was varied with different tillage and seeding method (Table 1). The highest number of plant per square meter (73) was obtained from power tiller operated seeder (PTOS) method treatment which was statistically identical with two wheel tractor (2WT) and seed broadcasting (56). The increase in number of plants per square meter might be influenced by tillage and seeding methods. The lowest number of plant per square meter (49) was obtained from the strip tillage (ST) treatment which significantly identical with two wheel tractor (2WT) and seed broadcasting (56). These results are in line with those reported by [13].

TABLE 1
EFFECT OF DIFFERENT TILLAGE AND SEEDING METHOD ON TILLAGE DEPTH, TILLAGE TIME, PLANT HEIGHT AND NUMBER OF PLANT OF MUNGBEAN

Treatment	Tillage depth (cm)	Tillage Time (min)/200 m^2	Plant Height (cm)	Number of plant/m^2
T1 (2WT)	4.71	24.13	32.39	56
T2 (PTOS)	5.42	11.06	34.33	73
T3 (ST)	4.72	8.02	30.30	49
LSD (0.05)	0.53	4.40	1.90	4.95
CV%	0.0153	0.0000	0.0011	0.0000

Number of pods per plant is an important yield determining factor. The data indicated that different tillage and seeding methods had significant influence on pod development in plant (Table 2). The highest pods per plant (25) were obtained from power tiller operated seeder (PTOS) method treatment which was statistically identical with two wheel tractor (2WT) and seed broadcasting (23). The increase in number of pods per plant might be influenced by tillage and seeding methods. The lowest pods per plant (20) were obtained from the strip tillage (ST) treatment which significantly identical with two wheel tractor (2WT) and seed broadcasting (23). The findings are accordance with of [8].

1000-seed weight

In case of plant characters, all the parameters showed significant variation except different tillage and seeding practices had less influence on 1000-seed weight (Table 2). It might be due to use of same variety in all treatments.

Seed yield

The data indicated that different tillage and seeding methods had a significant effect on seed yield of Mungbean (Table 2). The highest yield (1582.53 kg/ha) was obtained from seeding with power tiller operated seeder treatment which was statistically identical with the two wheel tractor tillage and seeding in broadcasting treatment (1412.96 kg/ha). The lowest yield (1306.96 kg/ha) was obtained from the strip tillage treatment which was statistically identical with the two wheel tractor tillage and seeding in broadcasting treatment (1412.96 kg/ha). But seeding with strip tillage treatment significantly differs from Power tiller operated seeder treatment (Table 2). It might be due the production of lowest number of pods per plants. These findings are line with those of [14].

Stover yield

The data indicated that different tillage and seeding methods had a significant effect on stover yield of Mungbean (Table 2). The highest yield (2328.23 kg/ha) was obtained from seeding with power tiller operated seeder treatment whereas the lowest stover yield (1708.38 kg/ha) was obtained from the strip tillage treatment. But seeding with two wheel tractor tillage and seeding in broadcasting treatment significantly differ from power tiller operated seeder treatment (Table 2). These findings are on accordance with [9].

TABLE 2
EFFECT OF DIFFERENT TILLAGE AND SEEDING METHOD ON NUMBER OF POD PER PLANT, POD LENGTH, 1000 GRAIN WEIGHT, GRAIN YIELD AND STOVER YIELD OF MUNGBEAN.

Treatment	Number of pod/plant	Pod length (cm)	1000 grain weight (gm)	Grain Yield (Kg/ha)	Stover Yield (Kg/ha)
T1 (2WT)	23	0.83	50.18	1412.96	1924.81
T2 (PTOS)	25	0.85	50.64	1582.53	2328.23
T3 (ST)	20	0.79	48.73	1306.34	1708.38
LSD (0.05)	3.17	0.02	5.65	53.66	50.48
CV%	0.0078	0.0000	0.0422	0.0000	0.0000

Yield was significantly influenced by different tillage and seeding treatments as per replication (Fig. 1). It was observed that the highest yield was obtained with power tiller operated seeder. On the other hand the lowest of yield was shown by strip tillage treatment. It was also observed that two wheel tractor and seeding in broadcasting showed intermediate results compared to all other treatments. These results are agreement with those of [1].

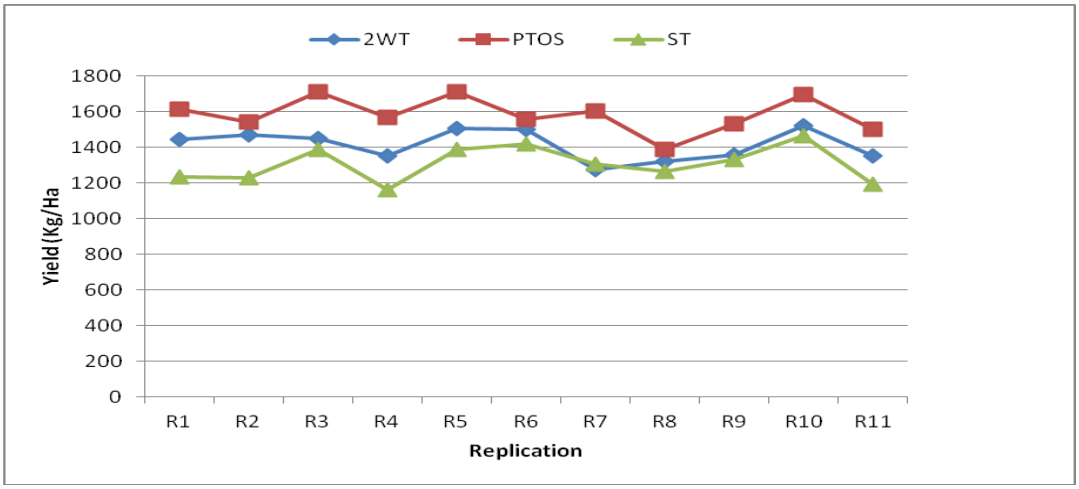

FIGURE1. YIELD OF MUNGBEAN AT DIFFERENT TILLAGE AND SEEDING METHOD AS PER REPLICATION.

IV. CONCLUSION

The results showed that some of the variable and crop characters in case of tillage depth, tillage time, plant height and number of plant of Mungbean were significantly influenced due to application of different tillage and seeding methods. The other parameters about yield and yield contributing characters such as number of pod per plant, pod length, 1000 grain weight, Grain yield and Stover yield of Mungbean were also significantly influenced by application of different tillage and seeding methods.

It may be concluded within the scope and limitation of the present study that the optimum growth and higher yield of Mungbean cv. BARI Mungbean6 could be obtained by mechanized cultivation of power tiller operated seeder (PTOS).

REFERENCES

[1] Ahmad, R., I. Mahmood, I. kamal, and S.A.H. Bukhari, 2004. Growth and yield response of three mungbean (Vigna radiata L.) cultivars to varying seeding rates. Int. J. Agri. Biol., 6(3): 538-540.

[2] Agriculture Information Service, 2013. Khamarbari, farmgate, Dhaka, Bangladesh.

[3] BBS (Bangladesh Bureau of Statistics), 2013. Year Book of Agricultural Statistics of Bangladesh. Statistics Division, Ministry of Planning, Government of Bangladesh.

[4] Bhaumik PK and AR Jha, 1976. Estimation of physiological relationship through path coefficient analysis of mungbean. Field Crop Abstr. 30: 6973.

[5] Elias SM, MS Hossin, FS Sikder, J Ahmed and MR Karim, l986. Identification of constraints to pulse production with special reference to present farming systems. Annual Report of the Agricultural Economics Division. BARI, Joydebpur. p-I.

[6] Fakir GA, MH Rashid, NN Tonu, AHMM Haque and M Rahman, 2007. Production and supply of quality healthy seed of pulse crops in Bangladesh News perspectives of pulses research in Bangladesh, proceedings of national workshop on "pulses for nutritional security and sustainable agriculture" held on 24-25 July 2007, BARI, Joydebpur, Gazipur, 239pp.

[7] Ganesh, Sah (1999). Performance Evaluation of Different Seed Drill in Farmers Fields. Annual Report. F.Y. 2056/57, Agricultural Implement Research Centre, Ranighat, Birganj, Nepal.

[8] Growda ST and Growda KTK, 1978. Influence of fertilizer on yield and its components of green gram. Field Crop Abstr. 33(11): 9022.

[9] Khan RA, 1970. Tech. Rep. Agron. Res. Department of agronomy, Univ. of Agric., Faisalabad, Pakistan.

[10] Malik BA, 1994.Grain legumes.In crop production, Nazir SE Bashir and Bantel (Eds) National Book Found, Islamabad, Pakistan.pp.277-326.

[11] Michael,M.A. and T.P.Ojha (1978). Principle of Agricultural Engineering, Vol. I. JAIN BROTHERS (New Delhi), 873, East Park Road, New Delhi.

[12] Nazma Shaheen, Abu Torab MA Rahim, Md. Mohiduzzaman, Cadi Parvin Banu, Md. Latiful Bari, Avonti Basak Tukun, MA Mannan, Lalita Bhattacharjee andBarbara Stadlmayr, Food Composition Table for Bangladesh-2013, Institute of Nutrition and Food Science, Centre for Advanced Research in Sciences, University of Dhaka, Dhaka-1000, Bangladesh.

[13] Panwar, J.D.S. and G.S. Sirobi, 1987. Studies on effect of plant population on grain yield and its components in mungbean. (Vigna radiata L.) Indian J. Plant Physiol., 30: 412-414.

[14] Sandhu TS, BS Bhullar, HS Cheema and JS Bhar, 1980. Path coefficient analysis for grain yield and its attributes in green gram. Field Crop Abstract, 34: 7338.

[15] Senanayake L, DP Knievel and SE Stevena, 1987. Nodulation and symbiotic nitrogen fixation of cowpea (*Vigna unguiculata* L.). Plant Soil, 99: 435-439.

[16] Zapata F, SKA Danso, G Hardarson and M Fried, 1987. Nitrogen fixation and translocation in fieldgrown fababean. Agronomy Journal, 79: 505-509.